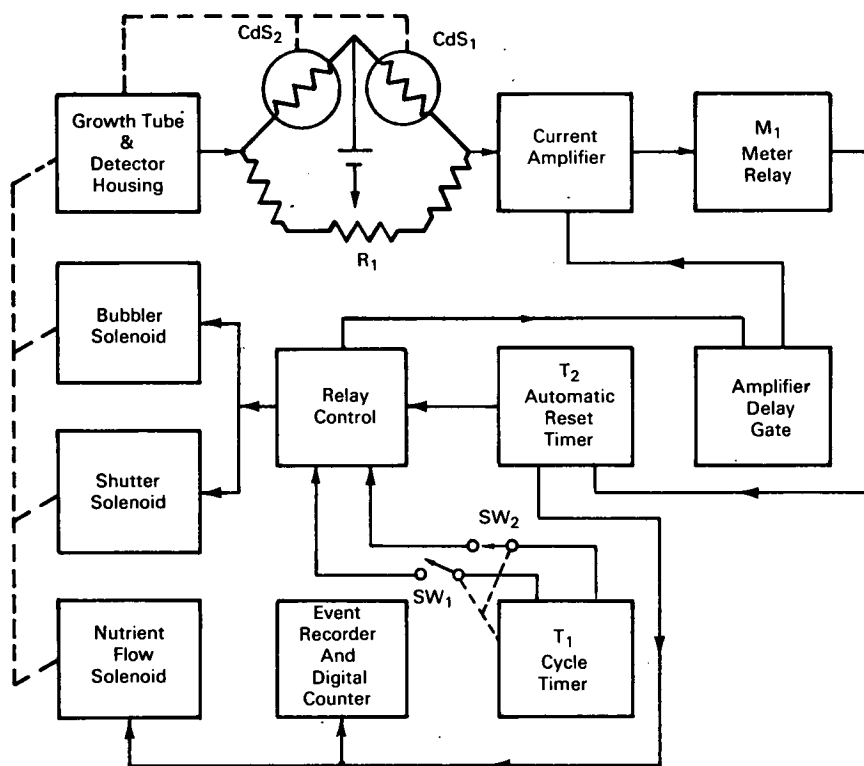


AEC-NASA TECH BRIEF



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Continuous Microbial Cultures Maintained by Electronically-Controlled Device



The problem:

To produce a device for growing microbial populations under steady state conditions. All existing devices are deficient in several respects for either routine continuous-culture experiments or for some specialized experimental applications.

The solution:

A photocell-controlled instrument was developed which: (1) utilizes ordinary commercially available chemostat glassware; (2) provides adequate aeration through bubbling of the culture; (3) maintains the

population size to within $\pm 3\%$; (4) maintains population density from less than 10^6 cells/ml to more than 10^9 cells/ml; (5) continuously records growth rates over small increments of time; and, (6) contains a simple, sterilizable nutrient control mechanism. The instrument maintains the turbidity of a continuous culture at a preselected value by controlling the influx of fresh nutrient solution into the culture, while keeping the total culture volume constant. The culture volume is held constant by means of an overflow siphon from a growth tube.

(continued overleaf)

How it's done:

Basically, the system consists of a growth tube and a nutrient feed system, which utilizes a modified Mariotte bottle and a single capillary for maintaining a constant nutrient flow rate. The capillary is large enough to yield flow rates greater than are required to maintain steady state conditions. Nutrient flow is then restricted to set requirements by a solenoid.

The bridge contains two cadmium sulphide photo-cells: CdS₁ is the detector cell, which is employed as a nephelometric device; CdS₂ monitors the light source, compensating for changes in the intensity of the exciter lamp. Bridge balance is accomplished by adjusting a mechanical slit and potentiometer R₁ for a given culture turbidity.

The electronic circuitry is cycled by timer T₁, a 1-rpm synchronous motor mechanically linked to Sw₁ and Sw₂. Before activation of Sw₁, certain conditions exist: the aeration bubbler is on; the shutter and the nutrient flow solenoid are closed; and the amplifier and meter relay are gated off.

The contactors driving Sw₁ can be set for two monitoring cycles during the 1-minute period of T₁, or one contactor can be removed and the second set for a single monitor event for the 1-minute cycle. When T₁ momentarily energizes Sw₁, the aeration bubbler is turned off, the shutter opens, and the amplifier and meter relay are gated on, following a 5-second delay. This assures that all bubbling action has been completed.

A contact closure of the meter relay M₁ is made if the turbidity reading is above the preset level. Then, (1) the automatic reset timer T₂ is turned on (T₂ has a maximum time range of 60 sec, but the range is limited by the cycle duration; preset time may be accurately set to 1-sec increments). (2) The nutrient flow solenoid valve opens and the feed is started for the duration of preset time. (3) The amplifier and

meter relay are gated off. (4) The aeration bubbler is turned on. (5) The shutter is closed. (6) The event recorder and digital counter record one event.

The amplifier continues to sample, an anticipation of either a contact closure from the meter relay or the opening of Sw₂ by T₁. Sw₂ can be programmed for either one or two cycles/min. In both cases, Sw₂ trips open at a preset level (15, 20, or 25 sec) after Sw₁ is energized, thereby ending the monitoring portion of the cycle.

If, however, the turbidity reading is below the preset level, the meter relays are not activated, T₁ opens Sw₂, and Sw₂ resets the control circuitry for the beginning of a new cycle.

Notes:

1. This device should be of use in fermentation research, production of metabolites, closed-life support systems, photosynthetic studies, and tissue culture studies.
2. Inquiries concerning this innovation may be directed to:

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Reference: B67-10556

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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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U. S. Atomic Energy Commission
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